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ABSTRACT

To investigate the development of children's knowledge of the intension and extension of four natural concepts (cup, scissors, money, and musical instrument), three questions were explored in an experiment involving one-hundred-and-twenty 3-, 5-, and 7-year-old children (40 children for each age group). Extension was measured in a verbal labeling task in which subjects were asked whether three exemplar and three distractor objects could be called by the name of the concept. For example, could each of the six objects used for the cup concept be called a cup. Intension was assessed in a conversation task in which children were asked three questions for each concept. For example, (1) What is a cup? (2) What is a cup used for? (3) Tell me all you know about a cup. Researchers first sought to specify the intension and extension of the four natural concepts. Second, they attempted to determine if intensional information was used by subjects to guide extension of their concepts. Third, they investigated whether or not making intensional information salient enabled subjects of all three ages to use intensional information to guide the extension of their concepts. Experimental group subjects received a demonstration of the function of the exemplars for each concept while the control group performed a drawing activity. Both groups performed labeling and conversation tasks. Results are discussed. (Author/RH)

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A Developmental Study of the Intension and Extension of Four Natural Concepts

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A DEVELOPMENTAL STUDY OF THE INTENSION AND EXTENSION OF FOUR NATURAL CONCEPTS

Both Anglin (1977, 1978) and Horton and Markman (1980) have shown that the intension of a concept does not always guide the extension of that concept for a young child. For example, Anglin (1977) found that although children aged 3 to 4 years defined FOOD as something you eat, they did not name a lollipop, Food. Moreover, Horton and Markman found that even when children were told correct intensional information it did not improve the accuracy of the 3 year old children's extension of the particular concept, although it did help improve the accuracy of older children's extension of two superordinate level (Rosch, 1978) concepts.

The present study was designed to examine the intension and extension of four natural concepts: Two relatively concrete or basic level (Rosch, 1978) -- CUP and SCISSORS -- and two relatively more abstract or superordinate level -- MONEY and MUSICAL INSTRUMENT. In the experiment, children from three different age levels (3, 5 and 7 years) were asked about the intension and extension of the four concepts. These two kinds of information were then compared to ascertain whether what the children knew about the intension of the concepts was being used to guide the extension of those concepts. On the basis of the results from Anglin

(1977, 1978) and Horton and Markman (1980), one might predict that the younger children would be less able than the older children to use intensional information to guide extension.

The experiment was also designed to examine the effect of making intensional information salient for subjects (cf. Horton and Markman, 1980). To that end, an experimental group of subjects received an initial demonstration in which the intensional information (the function of the objects) for each concept was made salient. This ensured that even if subjects were not initially aware of the intension of the concept, this experience would make this information salient for them. Moreover, it would show subjects that the intensional information for the concepts could apply to the new exemplars of the concept being presented in the experiment.

This experimental condition essentially replicated the conditions of the Horton and Markman study, in that, subjects were shown the intension of the four concepts, were tested on the extension of the concepts and then asked to verbalize the intension for each of the four concepts. If the results also replicate the Horton and Markman study, one might expect that experience with the intension of a concept would only help older subjects guide the extension of the superordinate level or abstract concepts.

In summary then, there were three major questions being tested in this experiment. First, what is the intension and

extension of four specific natural concepts for children who vary in age from 3 to 7 years? Secondly, does intensional information guide extension at all these age levels? Finally, what is the effect of making intensional information salient? Does it enable subjects of all ages to use this intensional information to guide the extension of their concepts?

Method

Subjects

The age range tested in this study included 3, 5 and 7 year old children (their mean ages were 3.7, 5.5 and 7.5 years, respectively). There were 40 subjects at each age level and these 40 subjects were divided into two groups of 20. Thus, half the subjects at each age level were assigned to the experimental condition and half were assigned to the control condition.

Stimuli

The stimuli for the experiment comprised six objects for each of four natural concepts. The six objects included three exemplars which were functionally similar (the intension of concepts such as CUP, SCISSORS, MONEY and MUSICAL INSTRUMENT is primarily defined in terms of function -- e.g., scissors are something to cut with), yet perceptually

dissimilar and three distractors which were functionally dissimilar to the exemplars yet perceptually similar to them. In fact, the three distractors were rated by adults as more perceptually similar to the exemplars than the exemplars were to one another. Thus, subjects who grouped the three exemplars together during the experiment were doing so on the basis of functional similarity (and thus according to the intension of the concept), rather than merely perceptual similarity.

Procedure

The procedure for the experiment differed for the experimental and control groups. Subjects in the experimental group received a demonstration of the intension (the function of the exemplars) for each concept, while subjects in the control groups did not receive this demonstration. Rather, they performed a drawing activity for the same amount of time as the demonstration engaged the experimental subjects. However, both groups performed the two experimental tasks: A verbal labelling task and a conversation task. These tasks were designed to examine the extension and intension of the four concepts and to gauge the influence of the intension demonstration across the three different age levels.

Specifically, each subject in the experimental condition was shown the six objects for the first concept s/he

was to receive (there were four orders of presentation). S/he was then engaged in the intension demonstration. This demonstration for the CUP concept involved filling the six objects with water. The true cups could hold water while the distractors could not. The intension demonstration for the SCISSORS concept involved cutting out shapes and again, the true scissors could cut while the distractors could not. The intension demonstration for the MONEY concept involved a game of store where the child could buy marbles from the experimenter wtih the true money while s/he could not buy marbles with the distractor objects. Finally, the intension demonstration for the MUSICAL INSTRUMENT concept involved playing a song on each of the objects. The exemplars could be used to play a song while the three distractors could not.

After the four intension demonstrations, the subject was engaged in the verbal labelling task. But before describing this task in detail, it is important to consider the procedure for the control condition.

Each control subject was first given a paper and pencil and then asked to draw a picture of his/her house. After about two minutes s/he was asked to draw a picture of a tree. After another two minutes, s/he was asked to draw a person and finally, after two more minutes, an animal. The purpose of this drawing activity was to keep control subjects occupied for the same amount of time as the intension demonstration engaged the experimental subjects.

Although the experimental procedure can be seen to differ for the experimental and control groups during this first phase of the experiment, the procedure was similar for both groups during the verbal labelling task and the conversation task. In the verbal labelling task, the subjects from each group were asked whether the objects for each of the concepts could be called by the name of the concept. For example, were each of the six objects for the CUP concept called a Cup. This task sampled the children's extension of each of the four concepts.

In the conversation task, subjects were asked three standard questions for each concept: What is a ____?, What is a ____ used for? and Tell me all you know about ____s. The blank was filled each time with the name of the concept. The object of this task was to assess more directly what the children knew about the intension of each of the four concepts. Ultimately this information could be compared to their performance on the verbal labelling task to see whether what they knew and could verbalize about the intension of each concept was used to guide the extension of that concept.

Results and Discussion

The results from the verbal labelling task are depicted in Figure 1. In this figure, the results for CUP and SCISSORS are pooled and presented under the heading CONCRETE. Similarly, the results for MONEY and MUSICAL INSTRUMENT are pooled and presented under the heading ABSTRACT.

Overall, there is evidence of a significant developmental trend in the ability to name the instances correctly and discriminate them from the distractors, $H(2) = 28.94$, $p < .001$. A multiple comparison procedure (Daniel, 1978) revealed that the 3 year olds produced significantly fewer correct responses that either the 5 or 7 year olds and that the 5 year olds produced significantly fewer correct responses than the 7 year olds. All these differences were significant at the .02 level. Thus, it seems that the older the subject, the more accurate was the subject's extension of each of the four concepts.

Also noteworthy is the effect of making intensional information salient for subjects. Mann-Whitney U tests were used to compare experimental and control group differences at each age level for the two concept types (concrete versus abstract). The experimental manipulation had a significant effect upon the 3 year olds ($U(20,20) = 85$, $p < .01$), the 5 year olds ($U(20,20) = 92.5$, $p < .01$) and the 7 year olds ($U(20,20) = 85$, $p < .001$) for the concrete concepts but

only the 5 year olds (U (20,20) = 88.5, $p < .01$) and the 7 year olds (U (20,20) = 133.5, < .05) for the abstract concepts. Thus, making intensional information salient significantly increased the likelihood that the 3 year olds would correctly name the exemplars of the concrete concepts but not the abstract ones. The effect of the experimental manipulation was significant for the older subjects for both type of concepts. However, it should be noted that while the manipulation did have a sigrificant effect at all three age levels it did not increase the performance levels of all groups up to ceiling. Thus, making the intensional information salient did not enable all subjects at all age levels to use the information to name the objects correctly.

The results from the conversation task are depicted in Figure 2. Here again, there is evidence of a developmental trend in the ability to verbalize the correct intensional information, H (2) = 37.78, $p < .001$. The multiple comparison procedure showed that the 3 year olds scored significantly less than the 5 and 7 year olds, while these latter two groups did not significantly differ. Again, the significant differences were at the .02 level. It appears then, that the 3 year olds are less knowledgable about the intension of the concepts than the 5 and 7 year olds. However, this effect seems to be largely due to the results from the abstract concepts since all groups are at ceiling for the concrete ones.

Mann-Whitney U tests were again used to test the effect of making intensional information salient for subjects. There were no significant differences between the experimental and control groups at any age level for any concept type. This is understandable for the 3, 5 and 7 year olds for the concrete concepts and for the 5 and 7 year olds for the abstract concepts since they were at ceiling on this task. However, it does suggest that the experience may not significantly influence the intensional information the 3 year olds possess and can verbalize about the abstract concepts.

Taken together, the results from the verbal labelling task and the conversation task suggest that all the 3, 5 and 7 year olds knew the intension of the concrete concepts and many (a half to three quarters) of the 3 year olds and most of the 5 and 7 year olds also knew the intension of the abstract concepts. However, the 3 year olds' extension of the four concepts was much less accurate than the 5 year olds' extension of these concepts and the 5 year olds' extension of these concepts was, in turn, less accurate than the 7 year olds'. This suggests that the younger subjects are less able to use the intensional information they knew to guide the extension of their concepts. This notion was directly tested in the present experiment through inter-task comparisons.

When subjects' performance on the conversation task was compared with their performance on the verbal labelling task, it was found that all the subjects in the control condition did significantly worse ($p < .01$) on the verbal labelling task than on the conversation task, for both types of concepts. The results were similar in the experimental group for the concrete concepts. Here again, subjects performed significantly worse ($p < .01$) on the verbal labelling task than on the conversation task. However, the results for the abstract concepts differed. Here the 3 year olds did worse on the verbal labelling task than the conversation task ($p < .01$) but for the 5 and 7 year olds, their performance on the two tasks did not differ.

It seems then, that the young subjects (3 year olds) were relatively unable to use all the intensional information they possessed to guide the extension of either their concrete or their abstract concepts, even after an experience where intensional information was made salient. This concurs with the results from Anglin (1977, 1978) and from Horton and Markman (1980).

The 5 and 7 year olds were only able to use all the intensional information they possessed to guide extension for the abstract concepts and then only after an experience where intensional information was made salient. It should be noted that this replicates the results from Horton and Markman's study where the intensional information was used

to guide extension by the older subjects (5 to 6 year olds in their study) but only for superordinate level concepts.

These findings are slightly puzzling. It seems counter-intuitive that subjects would first use their knowledge of intension to guide extension for the abstract or superordinate level concepts before the concrete or basic level concepts. However, there is a plausible explanation for these results: The exemplars for the concrete concepts shared both perceptual and functional similarity. The exemplars for the abstract concepts shared only functional similarity. Therefore when subjects were naming exemplars of the concrete concepts they may have preferred to rely on the obvious perceptual similarities rather than on the inferred functional similarity, or the intension of the concept, when they made their choices. In the present experiment, this would lead to making alot of errors since the perceptual similarity between instances and distractors was maximized and among instances was minimized. However, when subjects were naming the exemplars of the abstract concepts they needed to rely on functional similarity or the intensional information since the exemplars were not perceptually similar. Therefore subjects were able to perform more accurately on the abstract concepts than on the concrete concepts.

This explanation hinges on the hypothesis that subjects use perceptual similarity as a preferred strategy for naming

instances and that it is only when subjects are forced to use functional similarity (the intension of the concept) as a basis for their choices that they use it, if the are capable of using it. While this hypothesis needs further testing to assess its validity, there are two sources of evidence -- a study by Tomikawa and Dodd (1980) and a study by Prawat and Wildfong (1980) -- which indicate that it might be true. Both these studies present evidence that young children (3 to 4 year olds) find it easier to rely on perceptual similarity than on functional similarity (intensional information) to name exemplars correctly. This may be why children prefer to rely on this strategy.

In conclusion, it appears that even children as young as 3 know intensional information about relatively concrete concepts and many of these children also know intensional information about relatively abstract concepts. However, as Anglin and Horton and Markman have found with other concepts, the 3 year old's knowledge of intension does not reliably guide the extension of his/her concepts. In fact, 3 year old children do not seem able to use intensional information to guide their behavior even when circumstances require them to use the information -- for example, to name the objects for the abstract concepts correctly.

It is only with development that intension comes to guide the extension of concepts. There is evidence in the present experiment that this process is occurring in the 5 and 7 year olds. However, it should be noted that while

children in this older age group are capable of using intensional information to guide extension, they prefer to rely on perceptual similarity as a strategy to guide extension. It is only when circumstances require them to use intensional information (for the abstract concepts) that these children will use intensional information to guide the extension of their concepts.

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Figure 1. VERBAL LABELLING TASK

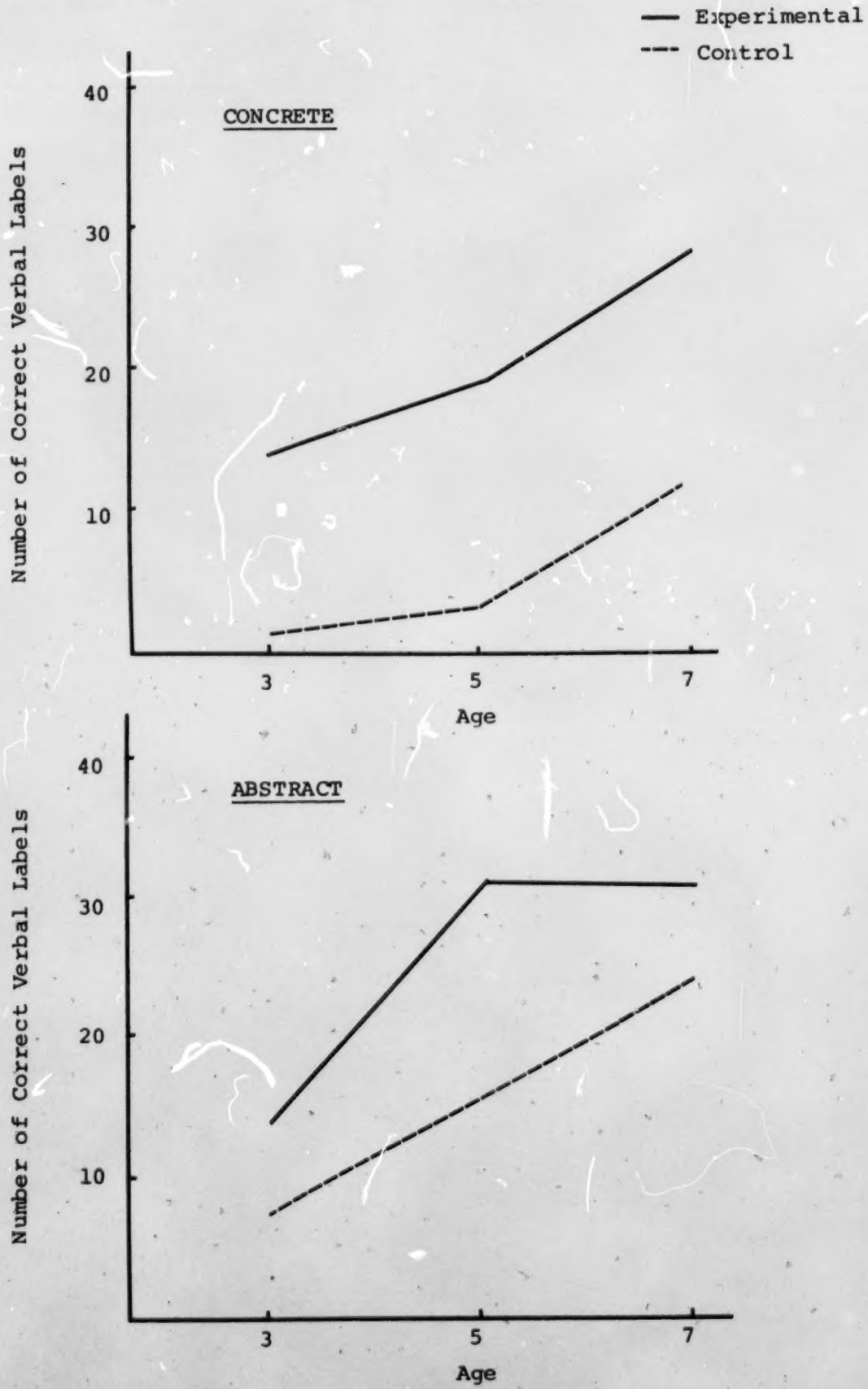

Figure 2. CONVERSATION TASK